

1 **ABSTRACT**

2 The system provides improved procedures to estimate head motion between
3 two images of a face. Locations of a number of distinct facial features are
4 identified in two images. The identified locations can correspond to the eye
5 corners, mouth corners and nose tip. The locations are converted into as a set of
6 physical face parameters based on the symmetry of the identified distinct facial
7 features. The set of physical parameters reduces the number of unknowns as
8 compared to the number of equations used to determine the unknowns. An initial
9 head motion estimate is determined by: (a) estimating each of the set of physical
10 parameters, (b) estimating a first head pose transform corresponding to the first
11 image, and (c) estimating a second head pose transform corresponding to the
12 second image.

13 The head motion estimate can be incorporated into a feature matching
14 algorithm to refine the head motion estimation and the physical facial parameters.

15 In one implementation, an inequality constraint is placed on a particular
16 physical parameter—such as a nose tip, such that the parameter is constrained
17 within a predetermined minimum and maximum value. The inequality constraint
18 is converted to an equality constraint by using a penalty function. Then, the
19 inequality constraint is used during the initial head motion estimation to add
20 additional robustness to the motion estimation.